Control Centre for Amateurs

An easily built unit which provides a compact control centre for the more modest amateur station, or for field operation. It features a mic preamp with compression, facilities for mixing, recording, relaying and duplex, a modulation level meter, and relays for T-R switching.

by JAMIESON ROWE

Amateur radio equipment seems to have an innate tendency to proliferate. Even after a short time the new amateur is likely to find himself with a number of receivers, transmitters, modulators, microphones and other equipment, many of which may duplicate functions. This can be costly, and it can also be confusing: it is all too easy to switch on the wrong gear, or to start speaking into the wrong microphone!

Although my own station is a very modest one, I realised some 15 months ago that it was tending to move in this direction. The answer became clear: look ahead as much as possible, try to plan a system which should perform the functions ultimately required, using the minimum number of separate units, and build each unit with that system in mind. Like New Year resolutions, such schemes have a habit of being carried more in the breach than in the observance, but I have tried to stick with this one so far and it has worked out rather well.

One area which seemed very suitable for simplification was the mic preamp and pre-modulator. Instead of each transmitter and modulator having its own preamp, the logical idea seemed to be to have a single mic and preamp, with a distribution amplifier used to pipe it to any of the transmitters or modulators at will.

The more I thought about this idea, the more facilities I wanted to build in — like mixing, switching for duplex, and so on. It soon became clear that the unit was becoming a sort of audio control centre, and the logical thing to do was to combine the unit with the basic T-R switching of the station. Hence was born the unit described in this article, which is probably best described as a "mini control centre" for modest stations.

What does it include? For a start, there is the mic preamp. This is followed by a simple mixer circuit, which allows a choice of either the mic signals, the output of a tape recorder or the audio from the receiver (for relaying). The mixer is followed by a distribution amplifier which can feed the signals to two or more transmitters or modulators, and also to a tape recorder. There is a level meter circuit across the distribution amplifier output, to allow monitoring of the modulation level.

The unit also includes a 15-ohm loudspeaker, intended to become the speaker for the master receiver of the system, and relays whose contacts are available for receiver and transmitter switching, and switching of the supply for an aerial changeover relay.

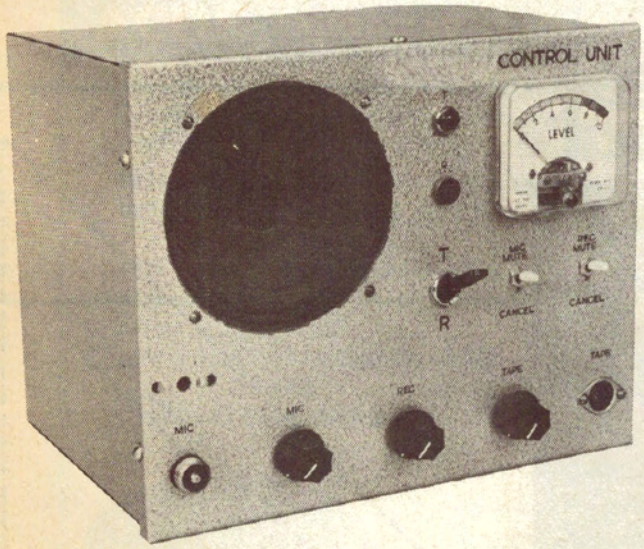
In short, the unit provides most of the facilities needed for a basic amateur station, other than the transmitters, receiver and aerials. And this all fits in a box measuring only 10 x 8 x 7in (255 x 205 x 180mm).

The compact size may also make it worthy of consideration by those amateurs who like operating out in the field. In fact it should be quite suitable for this purpose, as it could easily be adapted for battery power supply.

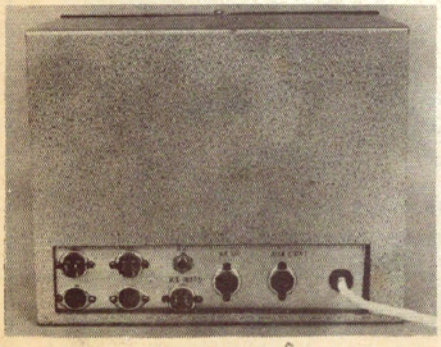
Radio amateurs are independent by nature, and are rarely known to build up published equipment designs in the form in which they are described. Therefore I do not expect that very many will wish to duplicate the unit as it stands, particularly as it was built up to suit my own specific needs. However I have decided to describe it here because at least some of the ideas which it incorporates seem likely to be of interest to other amateurs seeking to build up a unit of this general type.

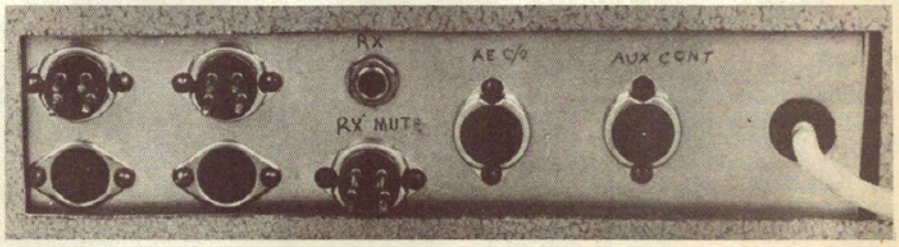
The main virtue I can perhaps claim for the unit in this particular form is that it has been in use now for about a year, and performs well.

The detailed design of the unit may be seen fairly easily from the circuit. The mic preamp may be familiar — it is actually the solid state compressor-preamp which was described in the February 1970 issue. This is an easily built unit, yet it performs well and gives good results with small AM and FM transmitters. It is based on a small printed

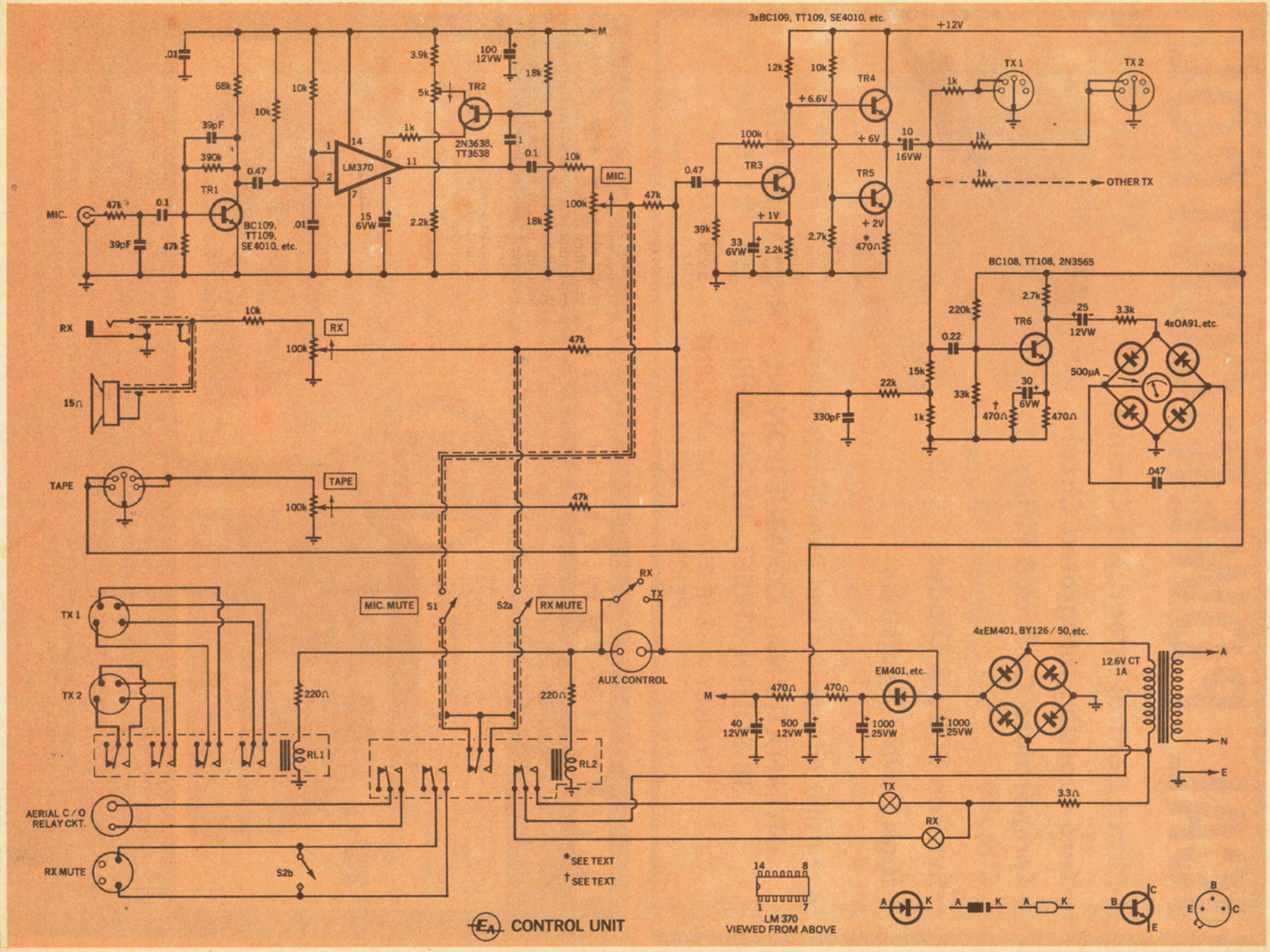


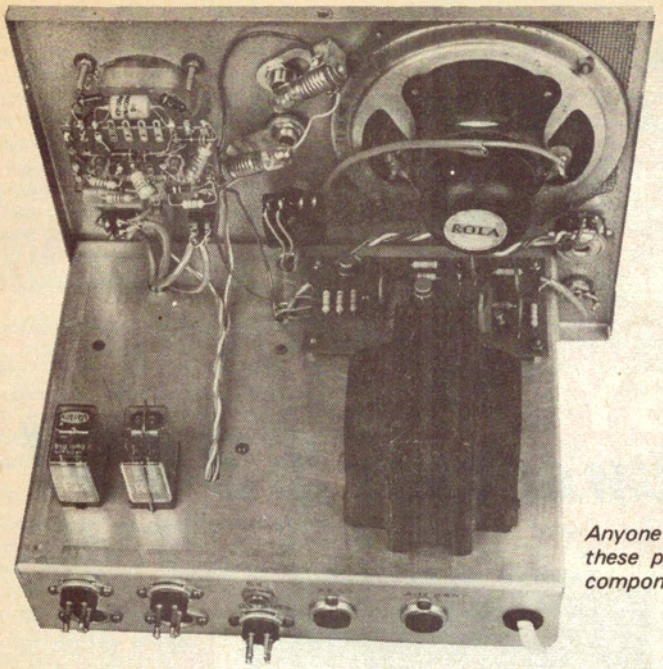
The compact control unit made by the author. The hole above the mic input socket is for screwdriver adjustment of compression level.

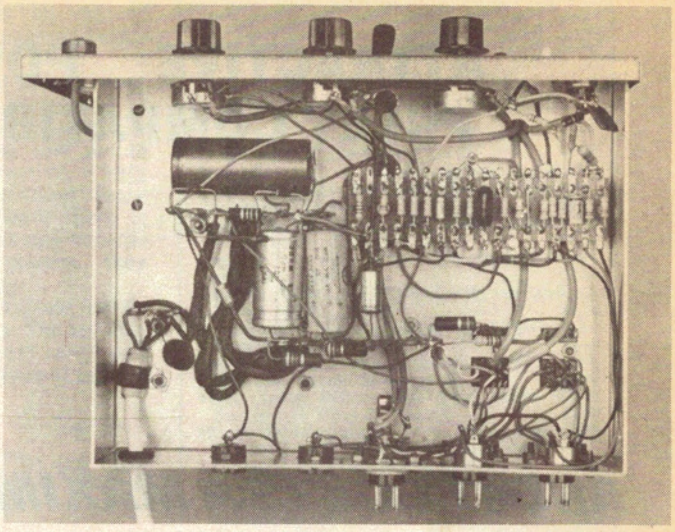




A rear view of the control unit (left) with a close-up of the various sockets (above). These are (from left to right) two plugs for transmitter switching with a socket under each for transmitter audio connectors, a jack for the speaker input, the receiver muting plug and sockets for the aerial changeover relay and auxiliary control.


3xBC109, TT109, SE4010, etc.
+12V
MIC.
47k
0.1
39pF
47k
TR1
BC109, TT109, SE4010, etc.
.01
68k
10k
10k
39pF
390k
0.47
LM370
3.9k
5k
TR2
2N3638, TT3638
100 12VW
18k
1k
1
0.1
10k
100k
MIC.
M
0.47
47k
15 6VW
2.2k
18k
TR4
TR3
TR5
+6.6V
+6V
+1V
+2V
100k
39k
33 6VW
2.2k
2.7k
*470Ω
10 16VW
TX 1
TX 2
1k
1k
1k
OTHER TX
BC108, TT108, 2N3565
2.7k
220k
TR6
25 12VW
3.3k
4xOA91, etc.
0.22
15k
22k
330pF
1k
33k
30 6VW
†470Ω
470Ω
500μA
.047
RX
10k
100k
RX
47k
15Ω
TAPE
100k
TAPE
47k
MIC. MUTE
S1
S2a
RX MUTE
RX
TX
AUX. CONTROL
4xEM401, BY126/50, etc.
EM401, etc.
12.6V CT 1A
A
N
E
M
470Ω
470Ω
40 12VW
500 12VW
1000 25VW
1000 25VW
TX 1
TX 2
220Ω
220Ω
RL1
RL2
AERIAL C/O RELAY CKT.
RX MUTE
S2b
TX
RX
3.3Ω
*SEE TEXT
†SEE TEXT
14
8
1
7
LM 370
VIEWED FROM ABOVE
A
K
A
K
A
K
B
C
E
B
E
C
CONTROL UNIT





Anyone wishing to follow the author's layout should be able to do so from these photographs, used in conjunction with the diagrams showing the component layout on the tag-strip and printed wiring board.

wiring board, code number 70/pl.

The heart of the preamp is a fairly complex linear IC, the LM370 (NS Electronics Pty Ltd). When the preamp was originally described, and when I built the control unit up, the LM370 was available in TO-5 package form. This is the form of the device for which the wiring board was designed. However since then the device has only been made in a 14-lead dual in line (DIP) package, so that those wishing to build up the unit now using the board will need to perform minor surgery to adapt it for the new package. The connections for the DIP package are shown on the circuit for guidance.

The preamp has a control which sets the output level at which compression occurs. If desired the control can be set so that the compression is virtually disabled (fully clockwise position).

The output of the preamp is taken via a 10k isolating resistor to the mixing circuit, which consists of three 100k log pots whose outputs are combined via 47k adding resistors. The other mixer inputs are connected to the monitor speaker voice coil, again via a 10k isolating resistor, and the 5-pin DIN socket used for interconnection to a tape recorder.

The rotors of the "mic" and "Rx" pots are also connected to muting relay contacts, used to ensure that the mic is normally rendered inoperative during receive and the receiver during transmit. However the connections are made via series switches, which may be used to disable the muting when not required — in order to operate duplex, for example.

The output of the mixing circuit feeds to the distribution amplifier, which is a straightforward design using three BC109 or similar high gain silicon NPN transistors. The output of the distribution amplifier is then made available via 1k isolating resistors to 5-pin DIN sockets used for connection to the inputs of transmitters or modulators. It is also fed via a divider network and a low-pass filter (for RF suppression) to the tape recorder socket.

The nominal audio output level of the distribution amplifier is approximately 500mV, so that it should be possible to provide at least 250mV at the input of each transmitter providing it has an input impedance of 1k or more.

Although only two transmitter output sockets are shown, you can easily add further sockets if required to cope with more transmitters. Up to two additional sockets may be added simply by wiring them in with a 1k resistor in series with each. However if more outputs are required, it would be desirable to increase the quiescent current in the output transistors of the distribution amplifier to prevent distortion on peaks.

This can be done quite easily by reducing the emitter resistor of T5 from its present value of 470 ohms. For example a value of 220 ohms should allow the circuit to operate with up to eight outputs. But do not reduce the resistor value below about 150 ohms, or you may run into overdissipation problems. Note that the exact number of transmitters which can be connected to the unit for a given quiescent current, before distortion occurs, depends upon the input impedances of the transmitters. The lower the input impedances, the fewer the transmitters which can be connected, and vice-versa.

Also connected across the output of the distribution amplifier is the level metering circuit. This uses a simple one transistor amplifier stage with a BC108 or similar general purpose silicon NPN transistor, driving a bridge rectifier and a standard 1mA meter movement. I used a locally made meter movement I had on hand, but one of the cheaper imported types available nowadays would be quite adequate.

As shown, the gain of the meter amplifier stage is set so that the meter reads 0.8 of FSD for the nominal output level of 500mV at the output of the distribution amplifier. However it is an easy matter to change the gain if desired, to correspond to a different output level. This is achieved simply by altering the value of the resistor in series with the 30uF emitter bypass capacitor. Increasing the resistor from its present value of 470 ohms will reduce the gain, while reducing it will increase the gain.

The T-R switching functions performed by the unit are carried out using two miniature relays. The relays I used have coils with a resistance of around 250 ohms; one is an STC unit, type number 250-AKO, the other is an English "Varley" which is very similar. Both have four sets of changeover contacts.

The contacts of one relay (RL1) are used solely for transmitter switching. Those of the other relay (RL2) are used for receiver muting, switching current for the aerial changeover relay, mic and receiver muting, and operation of indicator lights. The relays are controlled by a toggle switch, which becomes the main "T-R" control of the station. However a socket is wired in parallel with the switch so that T-R switching may be controlled remotely if required. In my case this is convenient as one of my aerial changeover switches is a manual one, to which I have fitted contacts to act as the remote T-R switch.

The power supply for the control unit is very straightforward. It uses a 12.6V centre-tapped transformer, with a bridge rectifier using EM401 or BY126/50 or similar 1A diodes. The indicator lamps are fed with AC, which is taken directly from the transformer via connections to the centre-tap and one end of the winding.

Power for the relays is taken directly from the output of the rectifier bridge, where a 1000uF electro is used as a reservoir. As the voltage at the bridge output is approximately 17V, 220 ohm resistors are used in series with each relay coil to limit the current to a value adequate for reliable operation.

The 12V required by the transistors and IC are derived from the bridge output via a series diode and RC decoupling networks. The series diode is used to ensure that the relay coils do not significantly drop the voltage fed to the transistors.

As noted earlier, the unit is housed in a case measuring 10 x 8 x 7 inches. This is a standard instrument-type case having a flanged front panel; my case was obtained from Heating Systems Pty Ltd, but other manufacturers would have similar types.

The layout of the front panel may be seen from the photograph, and should

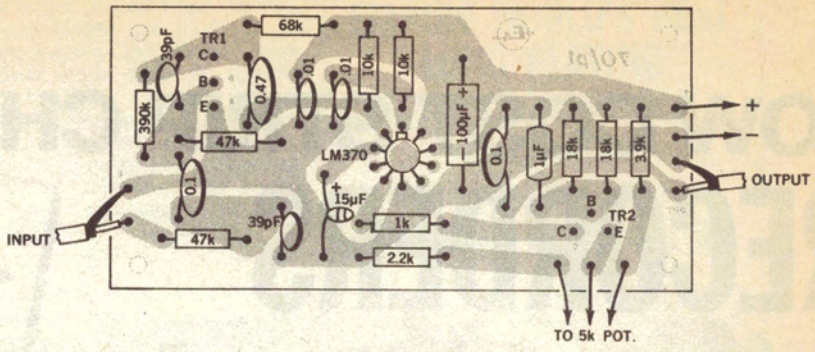
be fairly self-explanatory. The pot used for adjustment of compression level is a tab type, and is mounted above the mic input socket for convenient screwdriver adjustment. The two small switches below the level meter are S1 and S2, used for cancelling the mic and receiver muting when desired. Note that S2 has two poles, one of which (S2b) defeats the action of the relay contacts which normally break the receiver supply line during transmit.

A sturdy heavy-duty toggle switch having a relatively large lever is used for the main T-R control, for convenient and reliable operation. Above it are the two indicator lamps, that for receive having a green bezel while that for transmit has a red bezel.

With the exception of the mic input socket and the tape connector, all of the connectors of the unit are mounted on the rear apron of the chassis, a suitable clearance cutout being provided in the rear of the case. I have used 5-pin DIN sockets for the transmitter audio connectors, a phone jack for the speaker input, polarised two-pin sockets for the auxiliary control socket and the aerial changeover relay switching socket, and chassis-mounting 4-pin plugs for the transmitter switching and receiver switching connectors. The use of plugs for the latter obviates the risk of shock or accidental shorts.

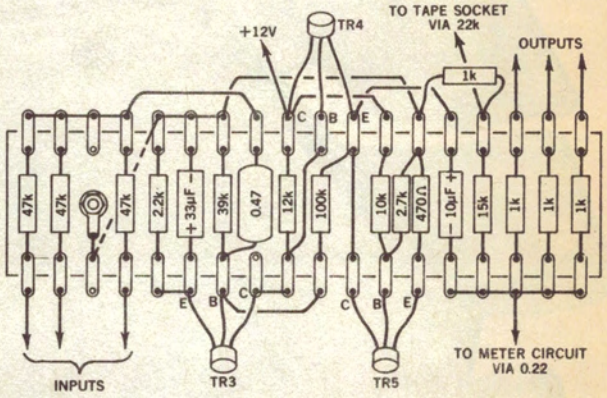
The layout of the unit is not particularly critical, and that of my own unit was chosen mainly to suit the components on hand. The preamp board, power transformer and relays were mounted above the chassis, with the remaining wiring beneath except for the metering amplifier stage. This is mounted on a small section of miniature resistor panel attached to the meter itself via the terminal screws.

The distribution amplifier wiring is mounted on a second section of miniature resistor panel. A diagram showing the placement of parts and wiring on this panel is shown on these pages for those who may care to copy it. The remaining wiring is supported on a few small tagstrips, as may be seen from the photographs.



(Above.) The component layout and printed wiring diagram for the preamp.

(Right.) The layout of the components on the main tagstrip under the chassis of the control unit.



Note that the 330pF capacitor across the tape output and the .047uF across the meter movement are for RF suppression. To keep RF from straying into the case I also used a piece of bronze fly-screen mesh as the speaker "cloth", and made sure that it was earthed.

Before concluding, it may be worthwhile to give brief details of the modifications which would be required in order to use the control unit for field operation. Basically this would only involve changing the power supply system so that everything operates off one or more 12V batteries.

If a 12V accumulator is to be used as the source of power it should be quite sufficient to connect it into circuit across what is at present the second 1000uF filter electro, substituting for the transformer, rectifier bridge, first electro and isolating diode. It would of course be necessary to change the indicator lamp wiring so that the lamps are also fed from the battery, but via a resistor of around 18 ohms (3W) instead of the present 3.3 ohms. The only other change would be to reduce the value of the resistors in series with the relay coils, in order to ensure reliable operation from the lower voltage. A value of 100 ohms should be satisfactory in most cases.

To operate the unit from dry batteries, the modifications needed would be very similar. However in this case it would be desirable to use two separate batteries. A heavy-duty 6V unit of the type intended for hand lanterns could be used for the indicator lamps and the relays (with the series resistors omitted), while a smaller 12V type could be used for the transistors. Again it would be fed in across what is at present the second 1000uF filter electro.

PARTS REQUIRED

1 Metal case, 10in x 8in x 7in or similar, with matching chassis.
1 Power transformer, 12.6V CT at 1A
1 Level meter, 500uA, 3in rectangular.
1 Loudspeaker, 15 ohms 5-inch diameter.
2 Relays, STC type 250-AKO or similar
1 Printed board, code 70/pl.

SEMICONDUCTORS

1 BC108,TT108, 2N3565 or similar.
4 BC109,TT109, SE4010 or similar
1 2N3638, TT3638, TT608, or similar
1 LM370 microcircuit.
5 EM401, BY126/50 or similar.
4 OA91 or similar.

RESISTORS (½watt, 5%)

1 x 3.3 ohms, 2 x 220 ohm, 5 x 470 ohm, 4 x 1k, 2 x 2.2k, 2 x 2.7k, 1 x 3.3k, 1 x 3.9k, 5 x 10k, 1 x 12k, 1 x 15k, 2 x 18k, 1 x 22k, 1 x 33k, 2 x 39k, 4 x 47k, 1 x 68k, 1 x 100k, 1 x 220k, 1 x 390k.
1 x 5k linear tab pot.
3 x 100k log pots.

CAPACITORS

2 x 39pF ceramic
1 x 330pF ceramic
2 x .01uF ceramic
1 x .047uF 160V polyester
2 x 0.1uF 100V polyester
1 x 0.22uF 100V polyester
2 x 0.47uF 25V ceramic
1 x 1.0uF 100V polyester
1 x 10uF 10VW electro.
1 x 15uF 6VW tantalum.
1 x 25uF 12VW electro.
2 x 30uF 6VW electro.
1 x 40uF 12VW electro.
1 x 100uF 12VW electro.
1 x 500uF 12VW electro.
2 x 1000uF 18VW electro.

MISCELLANEOUS

2 x miniature toggle switches, one SPST, one DPST: 1 x heavy-duty SPST toggle switch; 2 x indicator lamps, 6V incandescent type; 3 x knobs; 3 x 5-pin DIN sockets; 3 x chassis-mounting 4-pin plugs; 2 x polarised 2-pin sockets; 1 x mic socket; 1 x phone jack; 1 x 18-lug section of miniature resistor panel; sundry tagstrips, etc; mains cord and plug; scrap of metal screen material for speaker opening; screws, nuts, solder, etc.